GUIDE to the SILVICULTURAL MANAGEMENT of TREMBLING ASPEN in the prairie provinces

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INTRODUCTION

Most forest managers in Alberta, Saskatchewan, and Manitoba are aware that an untapped hardwood fiber resource has been staring them in the face for many years. Almost 30% (787 million m^3 or 27.8 billion ft^3) of the merchantable wood resource in the prairie provinces is in the form of trembling aspen[1]. However, only about 4% of the allowable cut is actually harvested each year.

Merchantable volume [a] of trembling aspen

	Trembling aspen	All species	Percentage
	(in million m^3)		
Alberta	538	1698	32
Saskatchewan	170	566	30
Manitoba	79	453	18
	787	2717	29

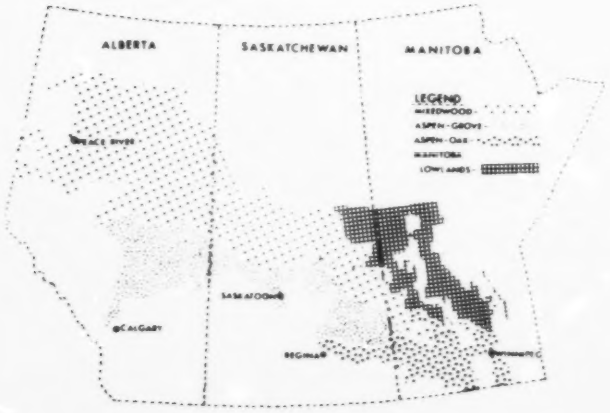
[a] 10 cm diameter at breast height (dbh) and up

The bulk of this resource grows in the Manitoba Lowlands and Mixedwood Forest Sections, which also contain the prairie region's best aspen growth. In the Aspen-Oak and Aspen Grove Forest Sections, aspen plays an important role as a recreational resource, as wildlife habitat, and in the form of windbreaks, as shelter for fields and farmsteads.

Principal uses of aspen to date have been for lumber, plywood, veneer, and particle board. While overall utilization is still low, it has increased recently because of the establishment of more aspen-using industries, and in local areas use has become intensive.

In expectation of increased utilization of trembling aspen throughout the prairies, this report presents management guidelines for sawlog and wood fiber production based on the ecological characteristics of the species, with implications of such management for other uses of aspen such as amenity and wildlife.

[1] *Populus tremuloides* Michx.



Four forest sections contain the bulk of the trembling aspen resource in the prairie provinces (from Rowe's Forest Regions of Canada, 1972)

ECOLOGICAL CHARACTERISTICS

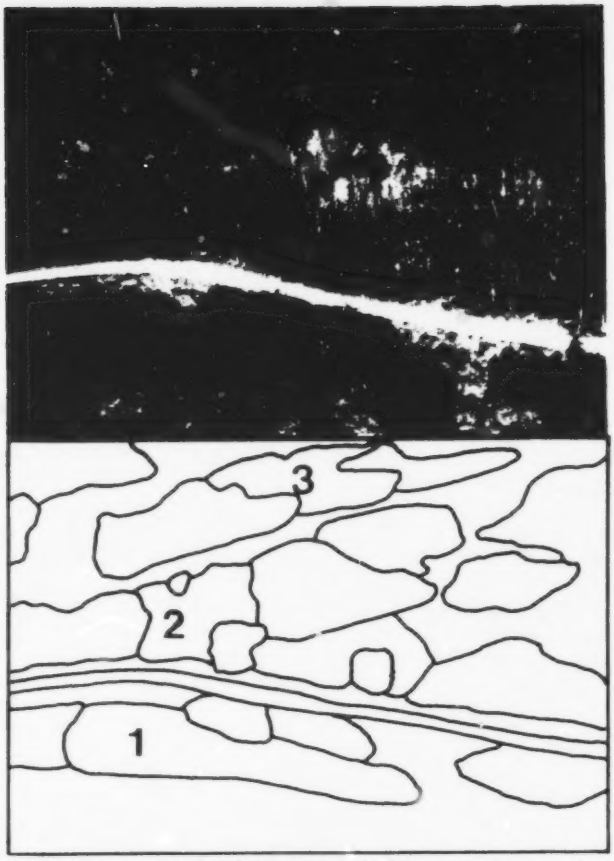
Regeneration

Trembling aspen is a relatively short-lived, fast-growing tree. It is dioecious; that is, male and female flowers are separate and are borne on different trees. The species will regenerate by seed but because the seed loses viability quickly after maturing and requires a moist seedbed for germination, regeneration by this method is uncommon. The best chance for seed germination and seedling survival is on an alluvial or humus seedbed with moderate temperatures, good drainage, and little competition from other vegetation.

Aspen suckers developing on a lateral root

The common method of reproduction is through suckers, which develop from the extensive lateral root system located just below the soil surface. Suckering is triggered when trees are cut or burnt, and promoted by the increased soil temperatures that result from the exposure of the soil surface to direct sunlight. The optimum temperature range for suckering is 20°-30°C. Amount of suckering depends on the degree of stand disturbance (number of overstory trees cut or burnt and amount of ground vegetation removed) and the inherent ability of the trees to sucker. Stand age does not affect suckering capacity, provided the stand is not breaking up due to old age and decay.

Suckers which develop from the root system of one parent tree are genetically identical and together are called a clone. All trees within a clone will show identical bark and leaf characteristics, stem form, and incidence or lack of decay. Many suckers within a clone, particularly at an early age, will have their roots interconnected. Clones can be identified easily in the spring and autumn because of interclonal differences in the timing of leaf flushing and leaf fall. Clones vary in size and may cover up to several hectares (acres).



Aspen clones are easily identified in the spring by differences in the timing of leaf flushing

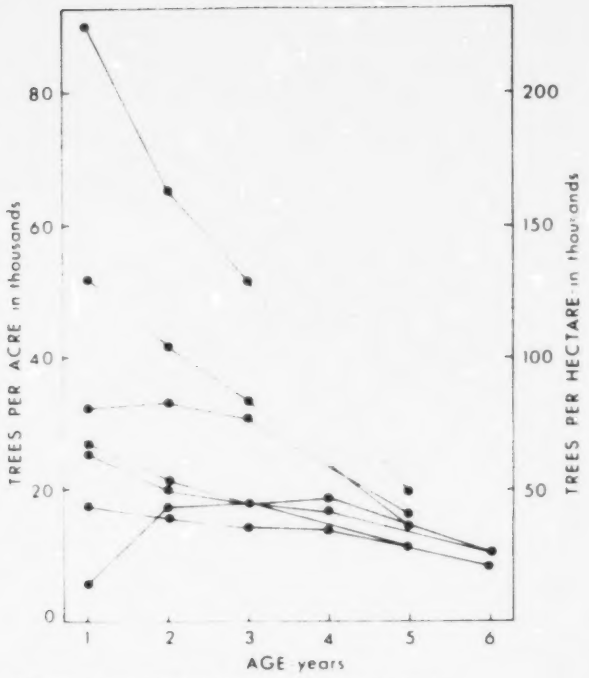
Stand Development

Initial stocking to suckers after harvesting or burning may vary substantially and can be as high as 200 000 trees/ha (80 000/acre). However, tree dominance is quickly established and high stocking levels are significantly reduced in the first few years through natural mortality. Fast-growing suckers will form the upper canopy of the stand, whereas slower-growing ones will quickly become suppressed and die. Vigorous suckers may grow as much as 2 m (6 ft) in their first year, but subsequent height growth will average between 30 and 60 cm (1-2 ft) annually, depending on site. Natural pruning, particularly in dense stands, is generally good, and clean boles will be produced.

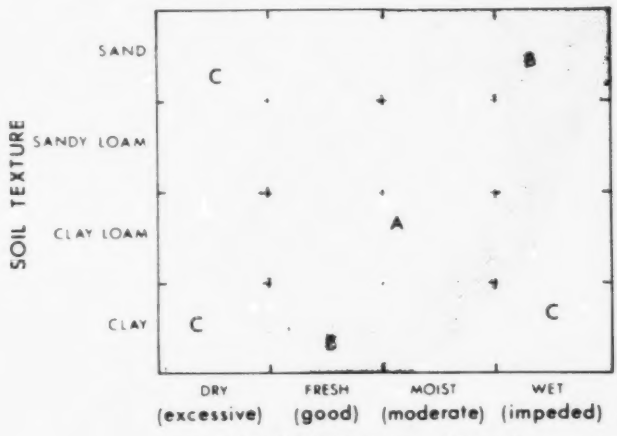
Aspen can inhabit a wide range of sites from dry sands to wet clays. However, growth will generally be poor on the dry sites and wet clays, and best on fresh to moist clay loams and moist sandy loams that have good drainage and a groundwater table within reach of the roots (i.e. at 2 m or 6 ft).

Site index at age 70 will vary from about 16 m (55 ft) on poor sites to 24 m (80 ft) on good sites, with corresponding stand volumes and average breast height diameters (dbh) ranging from 175 m^3/ha (2500 ft^3/acre) and 15 cm (6 in.) to 280 m^3/ha (4000 ft^3/acre) and 23 cm (9 in.) respectively.

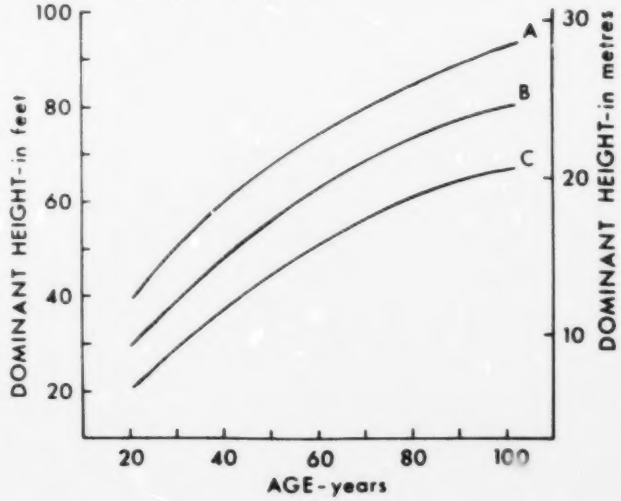
Height-age relationship of dominant aspen on good (A), intermediate (B), and poor (C) sites →



Reduction in aspen stocking as a result of natural mortality



Matrix of soil texture, moisture, and drainage conditions indicating good (A), intermediate (B), and poor (C) aspen sites



On fresh to moist sites, white spruce[2] is a common stand component. Under drier conditions jack pine[3] and white birch[4] will be found, while on wet sites balsam poplar[5] and black spruce[6] will be intermixed with aspen.

Individual trees on good sites may reach an age in excess of 100 years. However, stands usually break up much earlier, due to extensive decay and loss in vigor. Heart rot in the trunk causes the most serious cull losses in aspen. *Fomes igniarius*, a white decay with characteristic black zone lines, is responsible for about 35% of the decay in aspen. Fruiting bodies of the fungus are gray, hooflike conks with brown pore surfaces. Another serious rot is *Corticum polygonium*, a yellow brown stringy rot recognizable by small white crusts, often occurring on the underside of branch stubs. Decay establishes itself in the stem, primarily through dead branch stubs and stem wounds, even before age 20. However, actual volume loss will not occur until later. By age 70, the amount of decay may average 25% by volume and will increase rapidly thereafter. Decay losses tend to be more severe on poorer sites, primarily because of slow tree growth.

Fomes igniarius on trembling aspen

When aspen stands gradually break up due to age, shrub vegetation, particularly beaked hazel-nut and alder, commonly increases, thereby inhibiting aspen suckering. Unless a softwood component (e.g. white spruce) is present, the stand will become commercially nonproductive.

Throughout the life of an aspen stand attacks by defoliators such as the forest tent caterpillar and large aspen tortrix are quite dramatic. Although annual volume increment losses may be as high as 80% (3.5-7.0 m^3/ha or 50-100 ft^3/acre), they usually do not occur for more than 2 or 3 consecutive years, so that volume loss over a rotation is not significant.

[2]*Picea glauca* (Moench) Voss
[3]*Pinus banksiana* Lamb.
[4]*Betula papyrifera* Marsh.
[5]*Populus balsamifera* L.
[6]*Picea mariana* (Mill.) B.S.P.

MANAGEMENT

Harvesting and Regeneration

The principal objectives in managing trembling aspen stands for wood products should be 1) to secure adequate regeneration, 2) to maximize yields by controlling stocking throughout the rotation, and 3) to reduce rotation age and decay losses by ensuring rapid growth of high-quality trees.

Complete removal of the original stand together with the clearing of ground vegetation will ensure a fully stocked stand of suckers provided that the root system of the original aspen stand fully occupied the site. Cutting during the dormant season generally results in maximum suckering during the subsequent growing season. However, after 2 or 3 years the effect of cutting season (dormant versus growing) on sucker density is negligible. Therefore, as long as the parent stand is reasonably healthy and well stocked, clear-cutting can be carried out at any time. In derelict and overmature stands, which are likely to have heavy shrub vegetation, the preferred time for harvest cutting is during the frost-free dormant season. In such stands it is of particular importance that all shrub vegetation be removed. Most of this vegetation will be destroyed or uprooted if logging is by the "full tree" method (complete tree brought to landing). However, it may be necessary to subsequently treat the area with anchor chains or other equipment that will destroy any residual shrubs.

Suckering of aspen following clear-cutting in a mixed white spruce-trembling aspen stand

On fresh and moist sites residual slash after clear-cutting has not proved to be a significant hindrance to sucker formation and growth, and harvesting can be by the shortwood method (trees felled and bucked on the spot). On wet sites, however, slash may keep soil temperatures below the optimum range for suckering. To keep slash to a minimum on these sites and to provide for soil disturbance and destruction of shrub vegetation the full-tree harvesting method is recommended.

Although complete clear-cutting of fully stocked stands is recommended, scattered noncommercial residuals can be left, unless they shade the ground too much. The number of such residuals should not exceed 35-50/ha (14-20/acre), depending on their size.

A stocking of 6000 evenly spaced suckers/ha (2500/acre) during the third year after harvesting will be adequate, particularly for fiber production. For lumber production the number of suckers per hectare should be around 2500 (1000/acre).

Some browsing, particularly by deer, may occur on young suckers. However, lateral buds will develop if terminals have been eaten, and height growth of the suckers will not be set back significantly. Repeated browsing, though, could adversely affect stem form.

Mature trembling aspen stand with a heavy beaked hazel-nut understory

Stand Tending

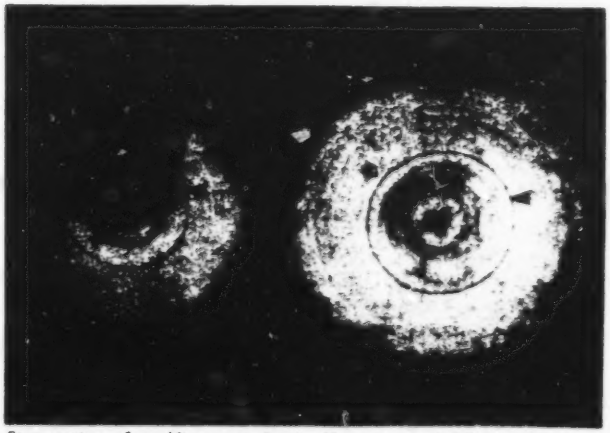
The end product desired will determine the required stand tending and rotation age. If trees are grown for fiber and all material can be utilized, the stand should be clear-cut when mean annual total volume increment has reached maximum. Considering stem volume only, this is likely to occur at an age of about 30 to 35 years, with stands on the best sites reaching this maximum somewhat earlier. On good (A) sites a yearly increment of about 7 m^3/ha (100 ft^3/ acre) can be expected. Considering total biomass, including branches and foliage, culmination of increment will occur a few years earlier and maximum increment per year of 2.5 t dry matter/ha (1 ton/acre) can be expected.

If sawlog material is desired, either selective or mechanical thinning can be carried out. To be most effective, thinning should be done not later than age 15, but preferably earlier. Even at age 5 suppression of diameter increment due to competition is possible in dense sucker stands. However, response to release in trembling aspen is excellent. Trees should be thinned to

Trembling aspen sawlogs

a spacing of about 2.5 m (8 ft) or 1600 trees/ha (650 trees/acre). If the initial thinning is noncommercial its cost must be weighed against the profit of increased sawlog production. To maintain rapid diameter increment, a second thinning is recommended about age 30 at which time the residual basal area could be reduced by about 35% to a stocking of about 1000 trees/ha (400 trees/acre). Such thinning will maintain vigorous diameter increment and will reduce rotation age for sawlog production (average diameter of 23 cm or 9 in. dbh) by at least 20 years from 70 to 50 years or less. If for economic reasons only one thinning is possible, consideration should be given to either a heavier thinning at age 15 to a spacing of 3-4 m (10-13 ft) or a thinning at about age 25 to a spacing of 4 m (13 ft). The early heavy thinning has the disadvantage of possibly causing overexposure and mortality among the residuals and heavy competition from excessive shrub growth. The disadvantage of the late thinning is that by age 25 a considerable amount of potential increment on residuals has already been lost through competition.

With mechanical strip thinning growth response tends to be limited to trees immediately along the strip edges. Therefore, with such thinning leave strips should not be any wider than 2 m (6 ft) and the width of cut strips should be about twice this amount.



Stem sections of trembling aspen showing 10 years' growth following the thinning of a 15-year-old stand to a 3.5-m (12 ft.) spacing

The effect of fertilization on growth is not known. However, in this part of the boreal forest where the growing season is short and moisture often limiting, it is doubtful whether fertilization will greatly improve growth. Furthermore, a good portion of any potential benefits from fertilization may be lost due to nutrient uptake by ground vegetation. Control of ground vegetation is likely to be a greater stimulus to growth than fertilization.

Pruning as a means of preventing decay entrance into the stem and to produce knot-free wood has not been fully assessed. Results from limited experimental trials indicate that pruned branch stubs up to a diameter of 2 cm will completely heal over within 5 years, provided diameter increment is maintained at about 0.5 cm per year (0.2 in.).

Strip thinning trembling aspen using a Fleco drum chopper

A 23-year-old trembling aspen stand thinned to a 3-m (10 ft.) spacing

Suggested management guidelines for tending aspen stands

Site	Product	Stand tending	Rotation
A — Good	Sawlogs	Thin to increase tree increment (1600 trees/ha at age 15, with further thinning at age 30 to 1000 trees)	50 years
	Fiber	Thin to salvage mortality (maintain stand basal area at 70% from normal starting at age 15 or before)	30-40 years ((30-40 if total tree utilized)
B — Intermediate	Fiber	As for A Fiber, thin to salvage mortality	35-45 years ((35-45 if total tree utilized)
C — Poor	Fiber	No stand tending and possible conversion to other species	—

Stand Improvement

Since suckers are obtained primarily from the root system of cut trees, it is possible, through selective cutting, to improve tree quality in a second generation through promotion of superior clones. Differences in average height between clones of up to 4.5 m (15 ft) at age 40 have been observed in Manitoba, and there are significant differences in the incidence of decay between clones. Two or three years before harvesting, trees from poor clones can be cut, provided that no large openings (e.g. maximum of 10 x 10 m or 33 x 33 ft) are created in the stand. Subsequent suckering will tend to be primarily from the poor-quality cut trees. In 2 or 3 years a harvest cut would then remove all residuals, and the previously formed suckers would be largely destroyed in the process. Regrowth from the destroyed suckers is likely to be less vigorous than sucker growth from the cut residuals, and eventually the more vigorous suckers will dominate. As an alternative, trees of nonmerchantable poor-quality clones can be left at harvest time, provided that they are uniformly scattered and do not prevent full exposure of the soil surface to incoming sunlight. The maximum number of such residuals should probably not be more than 35-50/ha (14-20/acre) or 10% crown cover. Suckering from these residuals would be low compared to that from the good-quality harvested trees.

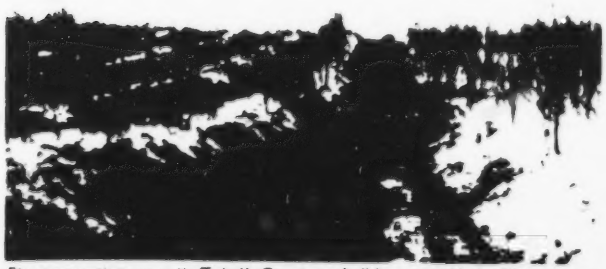
Occasionally, exceptionally high quality and fast-growing aspen clones may be encountered. Some of these may be triploids, which have an extra set of chromosomes in the cell. Propagation of such clones is possible through the collection of 1- to 2.5-cm (½- to 1-in.) thick root cuttings. Excellent sucker production from such cuttings can be obtained by placing them on sand flats in the greenhouse at about 25°C and supplying overhead water through a misting system for 0.5 min every half hour. After having attained a length of about 5 cm (2 in.), suckers can be detached and rooted in the sand flats, thus providing new treelets for outplanting.

CONTROL OF ASPEN

Short of removing all root material, no really effective and practical method exists to eliminate aspen and its suckers. Controlled burning has been tried; however, weather must be extremely dry for most of the humus and sucker roots to be consumed. If the burn is not complete, suckering may in fact be stimulated. Herbicides such as 2,4-D, applied to the foliage from the air or ground, will kill all above-ground tree parts but will not prevent suckering. A combination of herbicide treatment and controlled burning may possibly kill many sucker roots.

Herbicide spraying can be used to release understory softwoods. Because aspen trees thus killed will remain standing for up to 10 years, there must be a sufficient height differential between the two canopies to prevent leader whipping and ensure rapid growth. In stands where the softwood understory is just below the aspen crowns, mechanical damage cannot be avoided unless the aspen overstory is removed.

Trembling aspen killed by the aerial application of 2,4-D



Site preparation on an "off site" (C) using a bulldozer and blade. This area was later planted to jack pine and white spruce.

Stem injection methods using picloram or ammonium sulphamate have been effective in killing individual trees. Other aspen in the same clone with connecting root systems may also be killed and suckering reduced.

Where aspen is growing under "off site" conditions (C sites), stand conversion to another species can be considered. This can be achieved by preparing planting areas by scalping with a bulldozer blade or ploughing with equipment such as a Finn plough, depending on site conditions.

IMPLICATION OF ASPEN MANAGEMENT FOR OTHER LAND USES

Most other land uses are compatible with management for aspen wood fiber. Proper utilization and management of the aspen resource will ensure a continuation of the aspen cover type and provide forest stands of many age classes. These conditions are favorable to wildlife species. Ungulates such as deer, elk, and moose will benefit from harvesting operations because young suckers provide ample browse. Furthermore, aspen logging slash provides excellent winter feed for ungulates, rabbits, and hares. Because of their feeding and overwintering habits, ruffed grouse, an important and common inhabitant of aspen forests, will also benefit from a variety of stand age classes. Excessively high populations of big game would create conflicts with wood production because of overbrowsing of suckers and stem damage due to rubbing, but such conditions are not likely to occur in the prairies other than in national parks, where game is protected and production for wood fiber is restricted in any event.

Clear-cutting, even on a large scale, should not present a serious aesthetic problem. Regrowth of suckers from the residual roots is rapid and within 3 or 4 years most cutovers will be completely filled in with trees that have a height of at least 2 m (6 ft). Clear-cuts of up to 50 ha (125 acres), especially if they have irregular boundaries which follow the natural landscape, will be compatible with amenity and wildlife management, and no serious conflicts are envisaged.

SUGGESTED READING

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